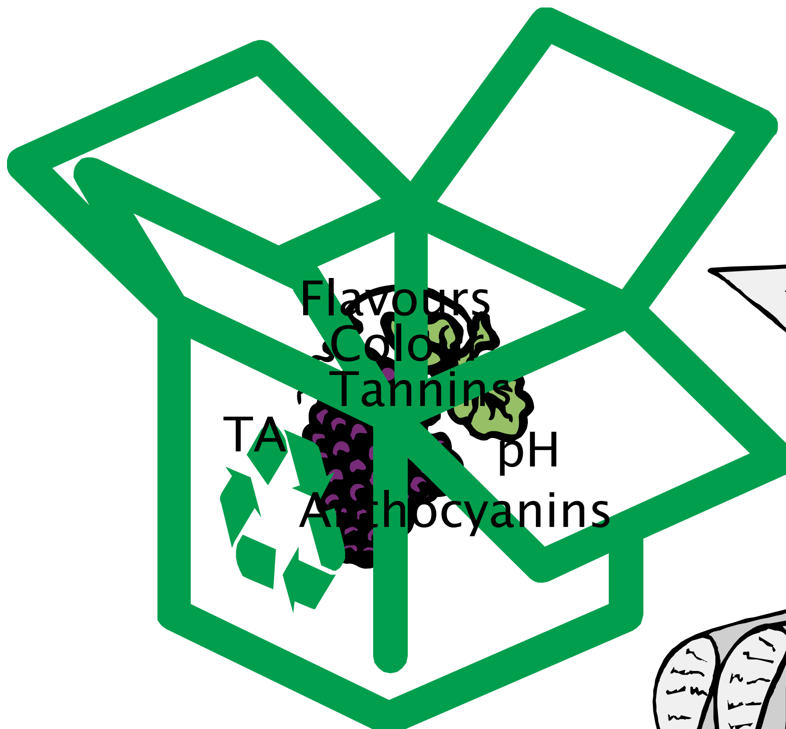
The impact of smoke exposure on different grape varieties

Renata Ristic and Kerry Wilkinson

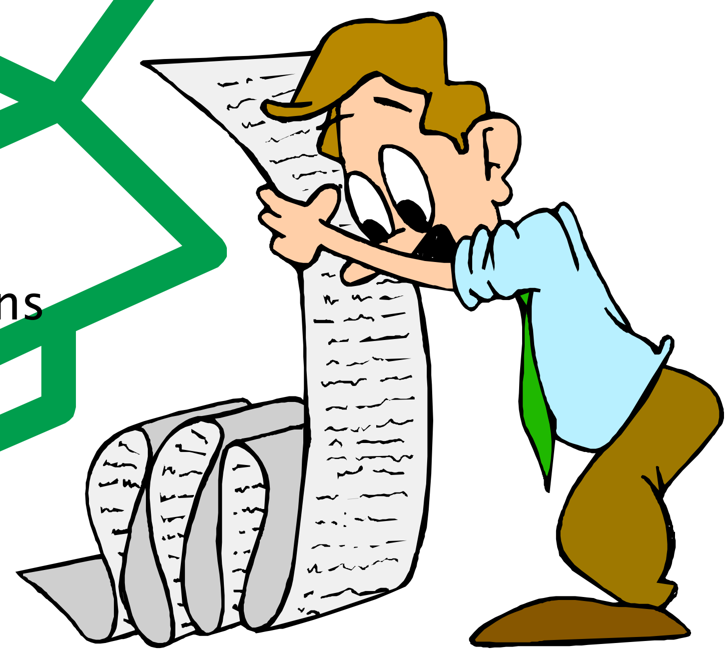
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Flavours
Colour
Tannins
TA
pH
Anthocyanins



SMOKE TAINT MAGIC BOX OF KNOWLEDGE



Volatile phenols associated with smoke taint

Volatile phenol	Aroma descriptors	Thresholds (µg/L)
Guaiacol*	Smoky, phenolish, sharp, sweet, burnt rubber	10
4-Methyl guaiacol*	Smoky, toasted, ashy, sweet	21
4-Ethyl guaiacol	Smoky, sweet, spicy, clove-like	25
4-Ethyl phenol	Smoky, horsy, medicinal,, barnyard, ashy	130
4-Vinyl guaiacol	Smoky, woody -fire	40
Syringol	Smoky, phenol, spicy	50
4-Methyl syringol	Smoky, ashy, medicinal	10000
Cresols (*o*-, *p*-, *m*-)	Smoky, ashy	20-68
? ? ?	Smoky, ashy	



Vineyard stories:

- Grape varieties
- Berry maturity
- Defoliation





Would defoliation make any difference?

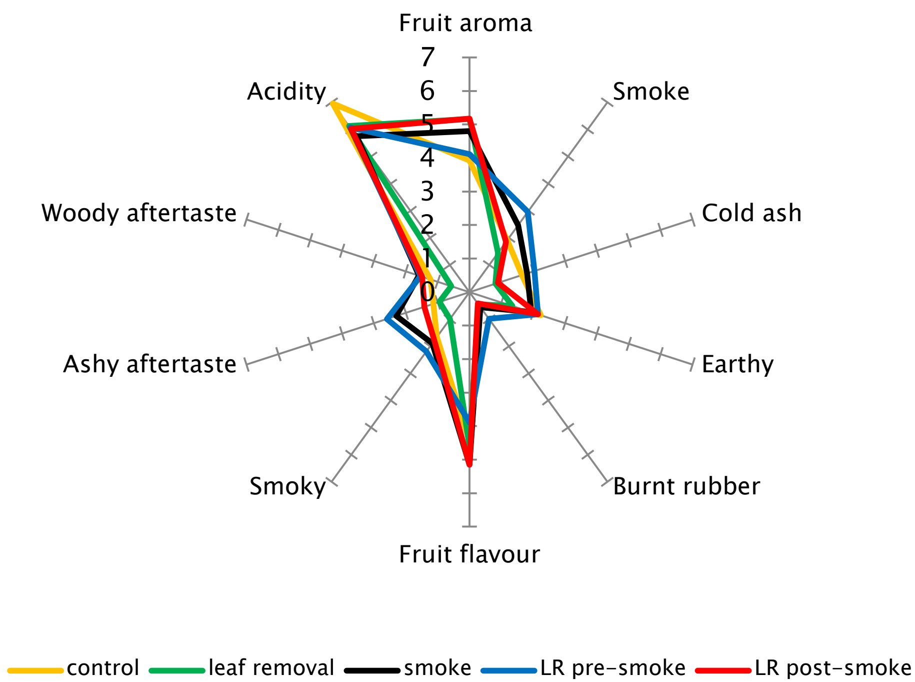
- Leaf removal pre smoke
- Leaf removal post smoke
- Control (no leaf removal, no smoke)
- Smoke (no leaf removal)
- Leaf removal (no smoke)



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	Experimental Treatments				
	‘control’	‘leaf removal’	‘smoke’	‘LR pre-smoke’	‘LR post-smoke’
Glycoconjugates (µg/L)	20 ± 1[c]	47 ± 10[c]	384 ± 53[ab]	496 ± 42[a]	365 ± 39[b]
Guaiacol (µg/L)	nd	nd	2.3 ± 0.3[b]	3.3 ± 0.9[a]	2.0 ± 0.6[b]



- Defoliation prior to smoke exposure gave wines with intense ‘smoky’, ‘ashy’ and ‘burnt rubber’ characters. This practice also significantly decreased the perception of ‘fruit’ attributes.
- Defoliation after smoke treatment reduced the intensity of ‘cold ash’ and ‘ashy aftertaste’ attributes compared with other ‘smoke’ treatments. ‘Fruit’ characters were perceived to be as high as in the defoliation treatment (no smoke) indicating that enhancement of ‘fruit’ characters by defoliation could partially mask theperception of ‘smoky’ characters.



Which grape variety is the most sensitive to smoke?

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White varieties:

- Sauvignon Blanc
- Chardonnay
- Pinot Gris

Red varieties:

- Shiraz
- Cabernet Sauvignon
- Merlot
- Pinot Noir

Vineyards located in Adelaide and in the Adelaide Hills

Viticultural parameters:

- Canopy architecture
- Sunlight intensity (% PAR)
- Leaf area
- Mineral composition
- Pruning weight
- Yield
- Y/PW
- Bunch number & weight
- No of berries/bunch
- Bunch architecture

Chemical analysis

- TSS
- pH
- Wine colour density
- Wine hue
- Anthocyanins*
- Phenolics*
- Brown pigments**
- Volatile phenols

Plant response

- Stomatal conductance
- Water potential
- NIR

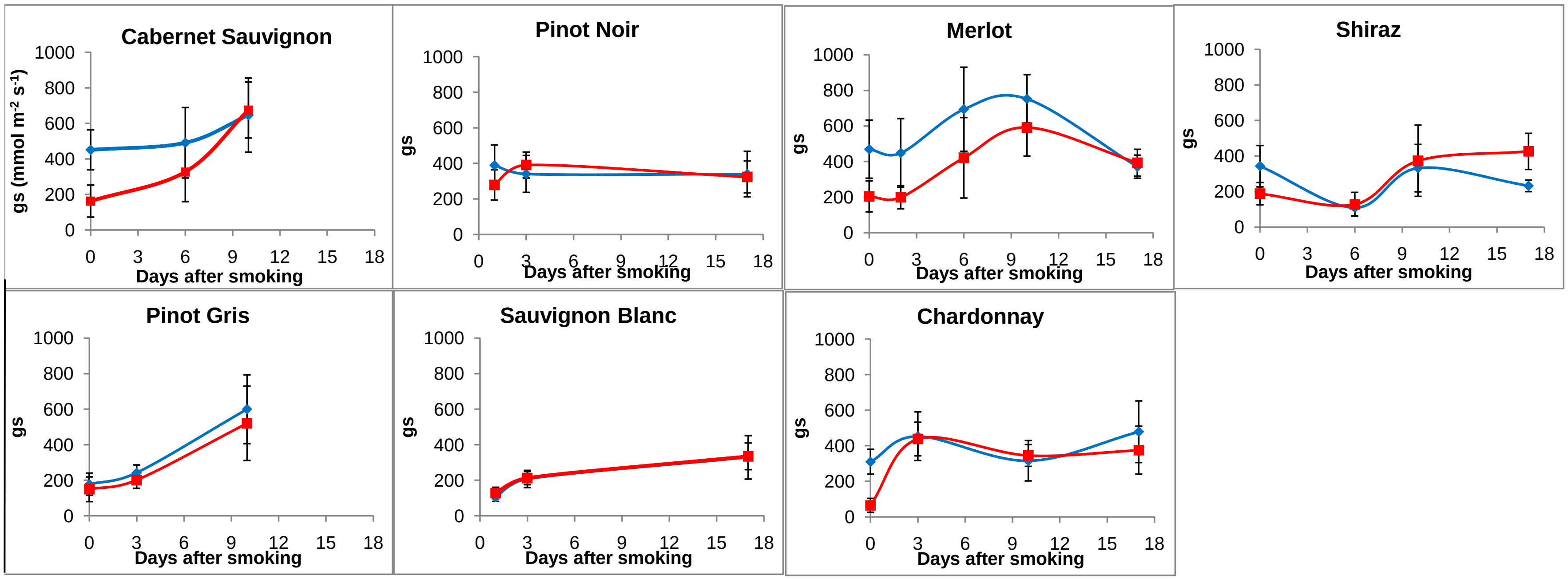
Sensory assessment

- Intensity of smoke related attributes
- Intensity of fruit aroma and flavour

Concentration of volatile phenols

Treatment	Total soluble solids (ºBrix)	Total glycoconjugates in berries (μg/kg)	Total glycoconjugates in wines (μg/L)	Guaiacol (μg/L)	4-methyl guaiacol (μg/L)	Total cresols (μg/L)	Syringol (μg/L)
Shiraz C	26.7 ± 1.0	602 ± 42	334 ± 5	9.0 ± 0.58	nd	3.3 ± 0.3	8.3 ± 0.3
Shiraz S	24.3 ± 0.1	1978 ± 199	1480 ± 151	26.0 ± 2.0	2.0 ± 0.0	9.7 ± 0.7	9.7 ± 0.7
Cab Sav C	23.0 ± 0.4	49 ± 3	39 ± 6	1.7 ± 0.3	nd	4.7 ± 0.3	7.3± 0.3
Cab Sav S	23.0 ± 0.1	662 ± 240	396 ± 78	20.0 ± 4.4	tr	17.0 ± 2.7	10.3 ± 0.3
Merlot C	22.7 ± 0.4	81 ± 7	54 ± 6	1.7 ± 0.3	nd	1.3 ± 0.3	5.3± 0.3
Merlot S	23.0 ± 0.1	2452 ± 1062	894 ± 61	17.0 ± 0.6	3.0 ± 0.0	12.3 ± 0.3	8.7 ± 0.3
Pinot Noir C	19.6 ± 0.4	56 ± 13	19 ± 1	nd	nd	1.0 ± 0.0	2.0 ± 0.0
Pinot Noir S	17.9 ± 0.2	253 ± 64	111 ± 17	6.0 ± 1.0	tr	8.0 ± 1.0	3.3 ± 0.3
Chardonnay C	19.9 ± 0.2	65 ± 4	9 ± 1	nd	nd	nd	nd
Chardonnay S	19.7 ±0.1	703 ± 136	213 ± 32	1.0 ± 0.6	nd	tr	tr
Sav Blanc C	20.3 ± 1.6	37 ± 4	10 ± 2	nd	nd	nd	nd
Sav Blanc S	23.6 ± 2.7	1075 ± 338	180 ± 37	1.7 ± 0.3	nd	tr	1.3 ± 0.7
Pinot Gris C	20.3 ± 0.8	45 ± 2	8 ± 1	nd	nd	nd	nd
Pinot Gris S	21.0 ± 0.4	550 ± 183	306 ± 66	9.7 ± 0.9	tr	8.3 ± 1.2	2.3 ± 0.3

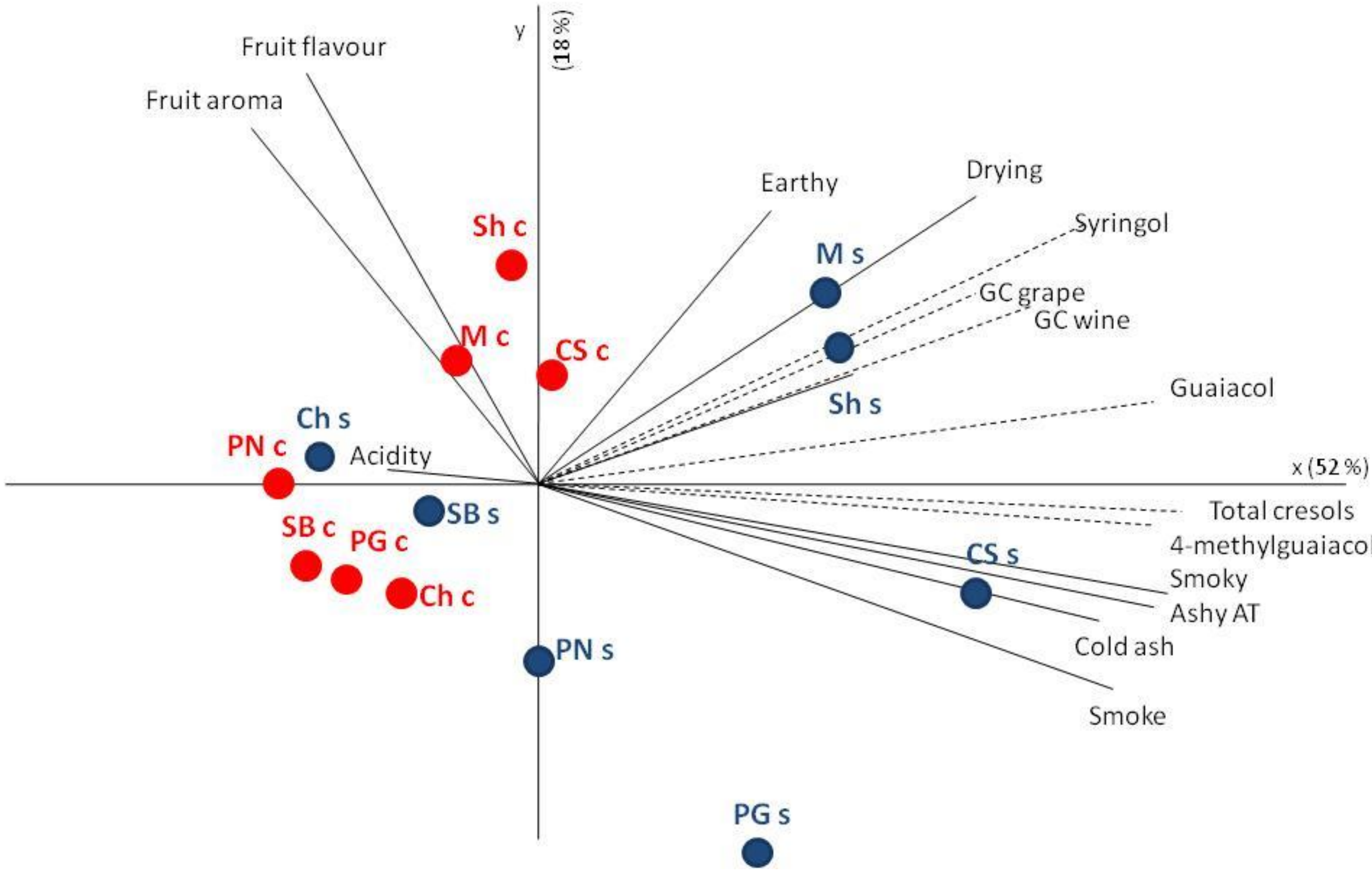
Recovery of stomatal conductance



Concentration of volatile phenols

Treatment	Total soluble solids (ºBrix)	Total glycoconjugates in berries (µg/kg)	Total glycoconjugates in wines (µg/L)	Guaiacol (µg/L)	4-methyl guaiacol (µg/L)	Total cresols (µg/L)	Syringol (µg/L)
Shiraz C	26.7 ± 1.0	602 ± 42	334 ± 5	9.0 ± 0.58	nd	3.3 ± 0.3	8.3 ± 0.3
Shiraz S	24.3 ± 0.1	1978 ± 199	1480 ± 151	26.0 ± 2.0	2.0 ± 0.0	9.7 ± 0.7	9.7 ± 0.7
		3 x	5 x	3 x		3 x	1 x
Cab Sav C	23.0 ± 0.4	49 ± 3	39 ± 6	1.7 ± 0.3	nd	4.7 ± 0.3	7.3± 0.3
Cab Sav S	23.0 ± 0.1	662 ± 240	396 ± 78	20.0 ± 4.4	tr	17.0 ± 2.7	10.3 ± 0.3
		14 x	10 x	12 x		4 x	1 x
Merlot C	22.7 ± 0.4	81 ± 7	54 ± 6	1.7 ± 0.3	nd	1.3 ± 0.3	5.3± 0.3
Merlot S	23.0 ± 0.1	2452 ± 1062	894 ± 61	17.0 ± 0.6	3.0 ± 0.0	12.3 ± 0.3	8.7 ± 0.3
		30 x	17 x	10 x		9 x	2 x
Pinot Noir C	19.6 ± 0.4	56 ± 13	19 ± 1	nd	nd	1.0 ± 0.0	2.0 ± 0.0
Pinot Noir S	17.9 ± 0.2	253 ± 64	111 ± 17	6.0 ± 1.0	tr	8.0 ± 1.0	3.3 ± 0.3
		5 x	6 x	6 x		8 x	2 x
Chardonnay C	19.9 ± 0.2	65 ± 4	9 ± 1	nd	nd	nd	nd
Chardonnay S	19.7 ±0.1	703 ± 136	213 ± 32	1.0 ± 0.6	nd	tr	tr
		11 x	24 x	1 x			
Sav Blanc C	20.3 ± 1.6	37 ± 4	10 ± 2	nd	nd	nd	nd
Sav Blanc S	23.6 ± 2.7	1075 ± 338	180 ± 37	1.7 ± 0.3	nd	tr	1.3 ± 0.7
		29 x	18	2 x			1 x
Pinot Gris C	20.3 ± 0.8	45 ± 2	8 ± 1	nd	nd	nd	nd
Pinot Gris S	21.0 ± 0.4	550 ± 183	306 ± 66	9.7 ± 0.9	tr	8.3 ± 1.2	2.3 ± 0.3
		12 x	38 x	10 x		8 x	2 x

PCA of wines made from smoke exposed and control grapes





Any maturity effect?

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Harvest A – berry maturity for sparkling wines

Harvest B – full berry maturity

Sauvignon Blanc Chardonnay

Effects on plant physiology →

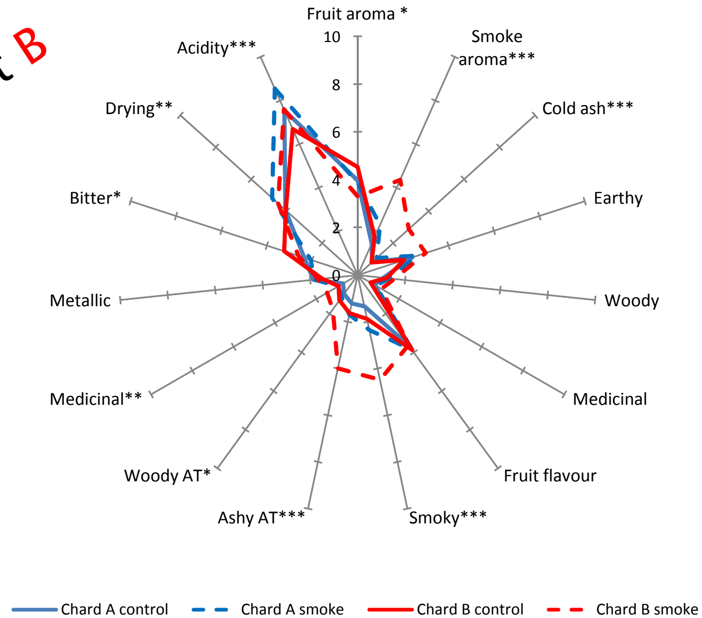
Shiraz Merlot

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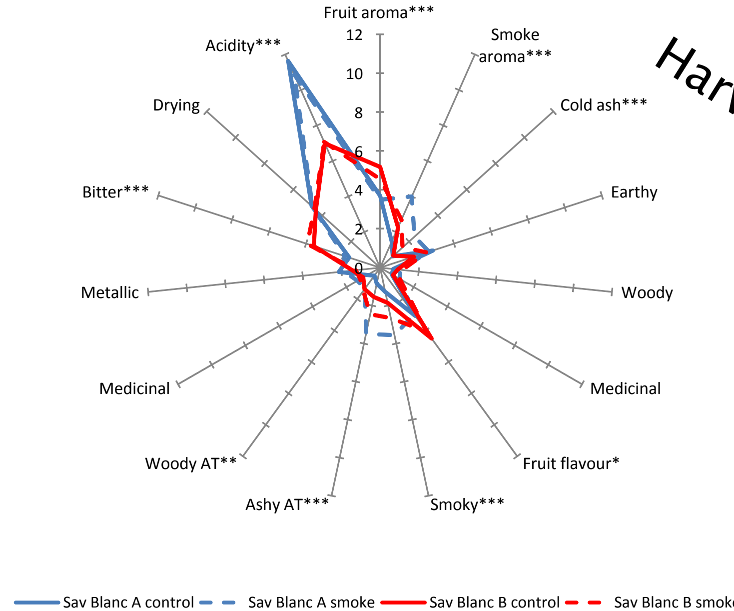
Harvest B

CHARDONNAY



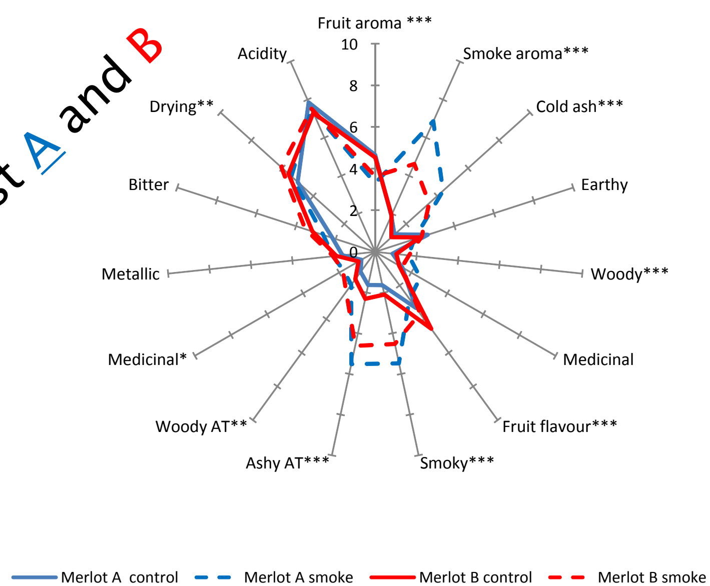
SAUVIGNON BLANC

Harvest A



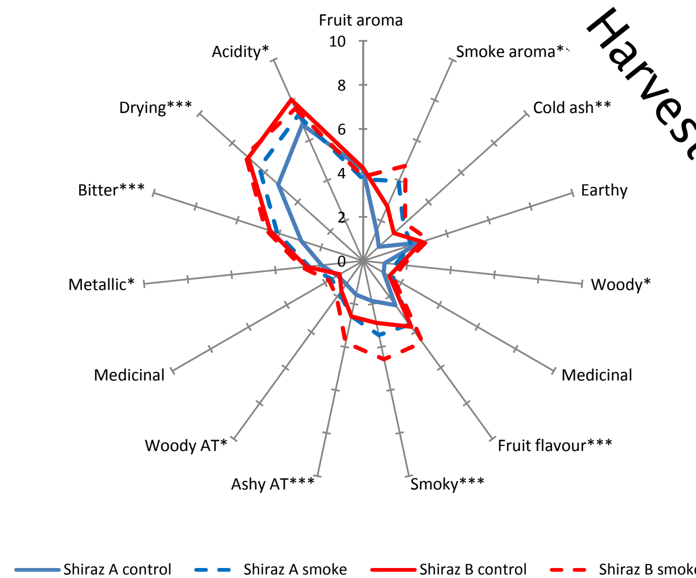
Harvest A and B

MERLOT



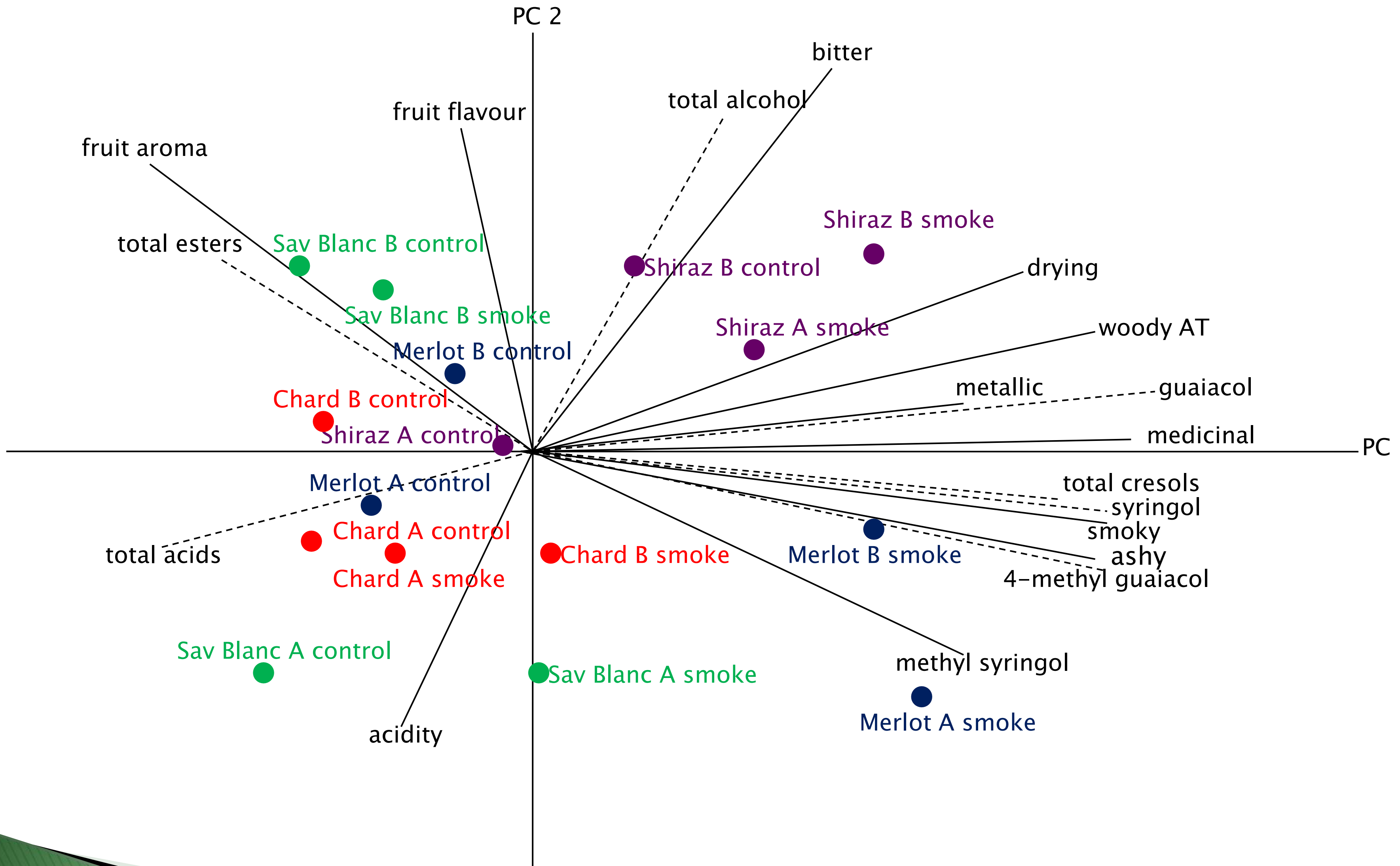
SHIRAZ

Harvest A and B



FLAVOUR COMPOUNDS AFFECTED BY SMOKE EXPOSURE

	Chard				SavB				Merlot				Shiraz			
	A		B		A		B		A		B		A		B	
	C	S	C	S	C	S	C	S	C	S	C	S	C	S	C	S
Guaiacol	nd	2.7	nd	2.0	nd	4.0	nd	2.7	tr	20.7a	1.0b	18.0a	7.7c	22.0b	10.7c	28.3a
4-methyl guaiacol	nd	tr	nd	tr	nd	1.0a	nd	nd	nd	6.3a	nd	5.3a	nd	3.3a	nd	3.0a
Syringol	nd	4.7a	nd	2.0b	nd	6.0a	nd	2.7b	2.0c	14.7a	2.7c	9.3b	4.7b	8.3a	6.3b	9.3a
Methyl syringol	nd	nd	nd	nd	nd	nd	nd	nd	nd	2.7a	nd	2.7a	nd	tr	nd	nd
Total cresols	nd	nd	nd	nd	nd	6.3	nd	nd	tr	4.3a	tr	5.0a	2.0c	3.7b	2.7c	6.0a



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The effect of smoke exposure on different grape varieties:

- Variability in plant response
- Variability in smoke uptake
- The effect of berry maturity differs

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